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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/960,670 | 09/21/2001 | Makoto Higashiyama | F-7168 | 5592 |

28107 7590 05/20/2004

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| EXAMINER | |
|---|---|
| LEHNER, WILLIAM P | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2671 | 7 |

DATE MAILED: 05/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/960,670 | HIGASHIYAMA, MAKOTO | |
| | Examiner | Art Unit | |
| | William P Lehner | 2671 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *01 March 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,2,4-9 and 11-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-9,11-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. 7.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 7, 8, 14, 15, and 16 are rejected under 35 U.S.C. 103(a) as being anticipated by Yasui (6356264) in view of Foley.

3. In regard to claim 1 and 15, 1. A three-dimensional image processing apparatus for creating a shadow image on the outer surface of a 3D model using a shadow model formed by a plurality of polygons, comprising: Note Yasui's image processing device and method for creating a shadow (column 1, lines 5-10). Polygons are in 3D coordinates (Yasui, column 4, lines 58-59) so that they may be combined to form 3D objects/models. The shadow falls on the outer surfaces of ordinary polygons (Yasui, column 7, lines 37-46 and FIG 6). A shadow volume formed by polygons (Yasui, column 1, lines 24-29). This shadow volume corresponds to the claimed shadow model.

4. Shadow model storage means for storing at least coordinates of vertices of the shadow model; Polygon data is stored in the polygon buffer 22 (Yasui, column 5, lines 6-8). Polygon data includes coordinates of vertices of polygons forming the shadow model (Yasui, FIG 3).

5. Polygon sorting means for sorting the polygons forming the shadow model into front-facing polygons facing in directions toward a viewpoint of a virtual camera and back-facing polygons facing in directions opposite from the viewpoint of the virtual camera; Shadow polygons are sorted into even and odd to determine shadow volumes (Yasui, column 4, lines 23-30 and FIG 1). The reverse hidden surface

cancellation process determines the even or odd status and records this in the light mask buffer 30. The sorting is based on the shadow polygon's Z-value inside the Z-buffer 28 (Yasui, column 6, lines 14-24). The Z-value is distance from the viewpoint, so polygons that are odd indicate facing towards the viewpoint and polygons that are even face away from the viewpoint. Starting at the viewpoint towards the bottom of FIG 1, when front-facing shadow polygon SP32 is encountered, the light mask value is odd and shadow volume SV3 is formed until back-facing shadow polygon SP31 is encountered. This creates a shadow on ordinary polygon OP from point b to point c.

6. Yasui does not use front-facing and rear-facing terminology to describe even and odd polygons. Foley teaches front-facing and back-facing terminology where front-facing polygons cause objects behind the polygon to be shadowed and back-facing polygons cancels the effects of a front-facing polygon (Foley, page 750, lines 4-7 and FIG 16.30). Foley's FIG 16.30 shows front-facing polygons A and B creating a shadow volume canceled by polygon C. In the same way, Yasui's FIG 1 shows shadow polygon SP32 creating a shadow volume cancelled by polygon SP31. Foley's textbook is influential in the computer graphics field. Franklin Crow was the first to describe shadow volumes (Foley, page 749, line 1) and he also uses this terminology. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yasui to use front- and back-facing terminology as taught by Foley because this terminology is conventional.

7. Model image creating means for creating an image by applying rendering to a polygon model except the shadow model; Rendering is applied (Yasui, FIG 5, step S24). The shadow model is not drawn (column 5, lines 27-30).

8. Model image storage means for storing the image created by the model image creating means while relating frame color data which are color data of pixels to Z-values, The model image created by the shading means of the rendering processor 34 is stored in the frame buffer 38 (Yasui, FIG 2). Frame color or raster pixel data from pixel data generator 24 is related z-values of the z-buffer 28 through z-comparator 26 and interpolator 32 (FIG 2 and column 6, lines 30-47). The vertex data used by the interpolator includes the vertice' s color data and z value (FIG 3). [Z-values] which are distances to the polygons corresponding to the respective pixels from the viewpoint of the virtual camera in a simulated three-dimensional space; and Polygon vertices have z-value parameters that store a depth within a display screen (Yasui, column 5, lines 15-19). This depth is a distance from the viewpoint (column 2, lines 13-15). Polygon vertices in polygon buffer 22 are transformed into pixels in the pixel generator 24 (FIG 2).

9. Shadow creating means changes the frame color data of the pixels stored in the model image storage means for shadow creating pixels which are: Rendering processor 34 is the shadow creating means and it shades pixels with shadow. Processor 34 calculates image data that includes color data (Yasui, column 6, lines 30-47).

10. Pixels corresponding to the front-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels, and

11. Excluding pixels corresponding to the back-facing polygons of the shadow model whose distances from the viewpoint of the virtual camera in the simulated three-dimensional space are smaller than the Z-values of the corresponding pixels. Yasui describes the z-value comparator for ordinary polygons in which the ordinary polygon's z-value is written into z-buffer 28 (column 6, lines 3-5). Next the z-comparator's reverse hidden surface cancellation processing is described for shadow polygons using the z-buffer 28 (column 6, lines 14-24); the z-value of buffer 28 would now hold a value of the shadow polygon. When the z-value of corresponding pixels is larger than the z-value of

buffer 28 the light mask buffer increments (column 6, lines 14-24). This condition is equivalent to when the z-value of a shadow polygon is smaller than the z-value of corresponding pixels:

$$Z_{\text{corresponding pixel}} > Z_{\text{shadow polygon}} = \text{increment light mask}$$

12. Is the same as:

$$Z_{\text{shadow polygon}} < Z_{\text{corresponding pixel}} = \text{increment light mask}$$

13. When the light mask buffer is odd, the region is judged to be inside the shadow volume and when the light mask buffer is even, the region is outside the shadow volume (Yasui, column 4, lines 23-30). The light mask buffer 30 undergoes odd/even conversion, so the value is either 0 or 1. When the buffer 30 increments from even to odd, a front-facing shadow polygon was encountered. When buffer 30 increment from odd to even, a back-facing shadow polygon was encountered.

14. Starting from the bottom of FIG 1 (Yasui), when shadow polygon SP32 is encountered buffer 30 increments from even to odd because the z-comparator found SP32's z-value to be less than the corresponding pixels. SP32 creates shadow volume SV3, a region where ordinary polygon pixels are shaded such as between vertex b and vertex c. When shadow polygon SP31 is encountered buffer 30 increments from odd to even because SP31's z-value was less than the corresponding pixels. SP31 cancels the effect of shadow volume SV3, excluding the shading of pixels outside that volume. SP32 is front-facing and SP31 is back-facing.

15. In regard to claims 7 and 14, Yasui discloses a graphics and gaming system with shadows for three-dimensional objects, but is lacking movable characters. Virtually every gaming system has movable characters because it is exciting to do so (Official

Notice). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yasui's gaming system with moving characters in order to have an exciting game.

16. In regard to claim 8, note Yasui's recording medium that stores a shadow-processing program (column 2, line 45-48), and the above rejections to claim 1.

17. In regard to claim 16, note Yasui's game program storage, input/output, operating unit, display means (FIG 10, elements 72, 73, 74, and 40), and the above rejections to claim 1. The I/O and operating unit allow for external operations.

18. Claims 2 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yasui (6356264) in view of Foley as applied to claim 1 above, and further in view of Minami (6542151). Yasui discloses an image processing method for creating shadows and a method of shading based on an inner product of normal vectors (column 6, lines 30-47). Yasui and Foley do not sort the polygons using an inner product; instead, they are counted as described in the above rejection to claim 1. Minami discloses a method of storing normal vectors of polygons and determining if these polygons are front-facing or back-facing based on the sign of their inner product (column 13, line 61 – column 14, line 14). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yasui and Foley's image processing method to store normal vectors and use an inner product as taught by Minami because the polygon orientation can be determined and the problems with Yasui's method is avoided.

19. Yasui counts the shadow polygons between the viewpoint and the examined position and if the count is odd the position is in shadow (column 1, lines 46-55). The problem with this is that a position in an area of intersecting shadow volumes will have an even count of shadow polygons and will be falsely judged to not be in shadow. It would have been obvious to avoid this problem by measuring the angle between the polygon and the camera vector to determine if the polygon is facing the camera, as taught by Minami.

20. Claims 5 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yasui (6356264) in view of Foley as applied to claim 1 above, and further in view of Yamaguchi (6529194). Yasui and Foley disclose an image processing method for creating shadows. They are lacking a method of shading by multiplying the frame color by the shadow color; instead they use Gouraud shading. Yamaguchi discloses a method of shading polygons multiplying their color value by beta (column 24, lines 1-2), so that texture mapping does not need to be performed (column 23, line 63). Beta refers to the intensity of the shadow. In the case of a point light source, beta is equal to 1.0 (Official Notice), which is a predetermined value. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yasui and Foley's image processing method to multiply the frame color by a predetermined value as taught by Yamaguchi because this method allows skipping the texture mapping.

21. Claims 4, 6, 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yasui (6356264) in view of Foley as applied to claim 1 above, and further in view of Nakatsuka (6433782). Yasui and Foley disclose an image processing method for creating shadows. They are lacking a method of shading pixels by subtracting the shadow color from the frame color; instead they use Gouraud shading. Nakatsuka discloses a method of shading polygons in the plotting region or frame buffer by subtracting their color value by shadow color (column 30, lines 41-53) because this calculates each pixel's luminance (column 30, line 41). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yasui and Foley's image processing method to subtract the shadow color from the frame color as taught by Nakatsuka because this calculates each pixel's luminance. The shadow color is a predetermined value, i.e. black.

***Response to Amendment***

22. The informalities in the specification have been corrected. FIGs 5 and 6 now show a viewpoint of the virtual camera and are acceptable.

23. Applicants representative argues that Yasui and Foley do not teach the limitations of claim 1, in particular the exclusion of shading the pixels that correspond to the back-facing shadow polygons. Both Yasui and Foley teach a shadow volume with a back-facing polygon that cancels the shading effects of a front-facing polygon, thus excluding the shading of pixels corresponding to the back-facing polygon and beyond until another front-facing polygon is encountered (explained in paragraphs numbered

5,6, and 11-14 of this action). Yasui and Foley's concept of a shadow volume bounded by back-facing polygons is the same as applicant's shadow volume. Foley's FIG 16.30 on page 750 resembles applicant's FIG 4.

24. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

25. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William P Lehner whose telephone number is 703-305-0682. The examiner can normally be reached on 8:30 - 5 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman can be reached on 703-305-9798. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

WPL